

Motorising a Lionel 1:120 scale GP9

These notes are based on my first experience motorising a Lionel 1:120 scale 'Big Rugged Train', using the existing chassis. I have liberally copied advice from members of the ttnut forum. Carsten Bauer's notes on motorisation from some years back are also of great help, and contain photos of the Tillig truck parts.

1. Components

Trucks

Tillig no longer seem to sell complete trucks, so the parts need ordering individually from modellbahnshop-sebnitz.de. Some parts were out of stock and were sent in a later batch; however, I had received all parts (to the UK) within about three weeks. Prices are correct as at March 2019.

There are wheelsets with traction tyres if required (part no. 207200) but I used the ones without.

Qty	Part no.	Item	Cost each	Total cost
2	202328	Stromfeder re., vollst. B (r-h pickup)	€ 2.40	€ 4.80
2	202329	Stromfeder li., vollst. B (l-h pickup)	€ 2.40	€ 4.80
4	207210	Treibradsatz sw B (wheelset)	€ 2.90	€ 11.60
4	307250	Stirnrad z19 br (spur gear)	€ 2.40	€ 9.60
8	323530	Zahnrad z11 br (gear wheel)	€ 1.90	€ 15.20
4	323550	Zahnrad z9 sw (gear wheel)	€ 2.40	€ 9.60
2	301430	Drehgestell Teil A sw B (truck side A)	€ 3.80	€ 7.60
2	301440	Drehgestell Teil B sw B (truck side B)	€ 3.80	€ 7.60
2	301450	Drehgestellverklgd. sw B (truck housing)	€ 5.80	€ 11.60

Drive train

From the same source.

Qty	Part no.	Item	Cost each	Total cost
2	303030	Kardanbuchsen für 1,5mm Achsen (cardan bush)	€ 0.33	€ 0.66
1	302774	Kardanwelle 14,5 sw (cardan shaft 14.5mm)	€ 1.40	€ 1.40
1	321050	Kardanwelle 11 sw 119/180 (cardan shaft 11mm)	€ 1.40	€ 1.40
2	200455	Schaft, mont. Sw (worm)	€ 5.80	€ 11.60

As can be seen from this list I used two different length cardan shafts.

Motor

From China via ebay - Mitsumi 030 DC12V 13500RPM 1.5mm Biaxial Shaft Carbon Brush Motor, Item Number 222324465343

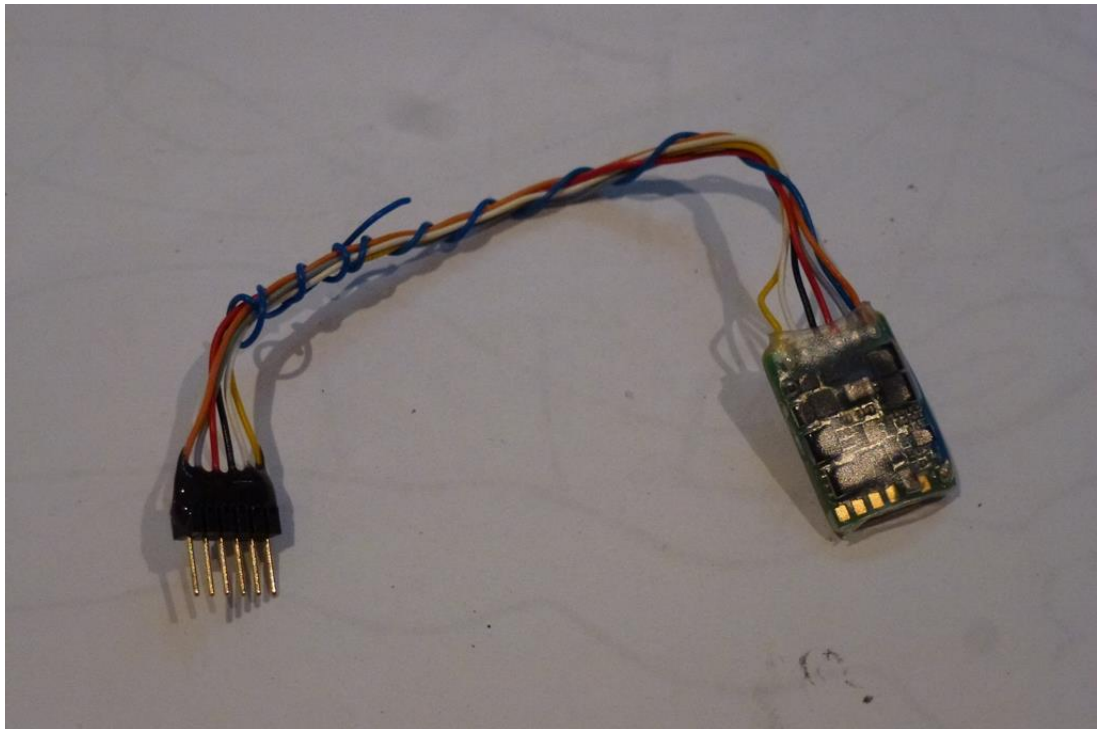
These cost less than \$8 for 10.

Light board: PCB suitably gapped

Lights: appropriate LEDs + resistors. I used two 3mm LEDs each with a 1k resistor.

Couplers: I used Kadee 713. These are the rust-coloured versions of the black 714. The new Kadee 705 should work too. I understand Micro Trains 1016, 1023 or 1025 are also suitable.

DCC decoder: I used a Zimo MX617F and cut the end plug off for hard wiring.



Lengths of thin brass to act as a heat sink and motor cradle.

2. Dismantling the model

The trucks take a bit of force to remove. The plug underneath the truck that holds it in place needs prising off with a small flat screwdriver or similar between the truck and the chassis plate. With a bit of force, the truck will pop off. The base will then slide off (mind the handrails, they're easy to break, and yes, I broke one).

The body shell has two pins (the ones that hold the trucks on) that run all the way to the roof and mount; use pliers to either unscrew them or break them off. I also had to file away some of the thread on the ends of the pins before the body would come away. I stuck masking tape over the handrail fixing holes to prevent the handrail lugs from popping back into the cab holes as I worked the body to and fro. It's a good idea to leave the tape in place until you've finished the conversion as you may have to test fit the body a few times.

Keep the trucks if you want to cut off and re-fit the sideframes.

Dismantled model – the truck sideframes can be cut off and used on the new trucks.



3. Assembling the new trucks

It's a good idea to unsolder the wires from the truck wipers and turn the wipers round so that the tapered edge is uppermost, and then re-solder the wires, taking care about positioning. This puts the wiper ends lower down against the wheels and makes it a lot easier to hold things in place while you get the truck housing clipped on. It may also make electrical contact more reliable.

Superglue the wipers onto the truck frames, aligning the small holes with the pins in the frames and the pickup wires in their grooves.

From then on assembling the trucks is fairly straightforward, contrary to what I'd expected. It's obvious where the different size gears go as their axles are different thicknesses but they all have to be the same way round to fit into the recesses in one side of the housing.

Grease the gears lightly. Don't fit the worm housings yet.

4. Preparing the chassis

Using drill bits of gradually increasing size and a half-round file, I made 9mm circular holes in the chassis for the trucks to swivel in, centred on the existing holes. Then I enlarged each hole at its outer end into a rectangular shape for the worm housing. For maximum truck rotation this rectangular opening should be at least as wide as the inside of the body shell (12.5mm).

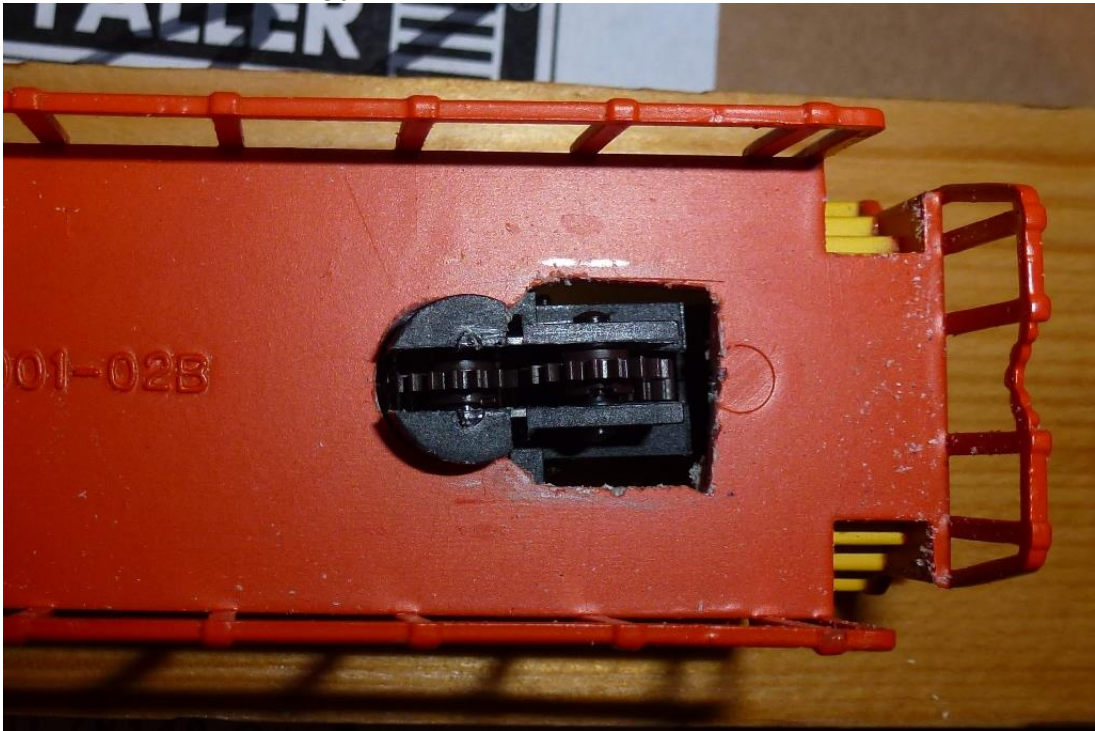
Don't open the circular hole out too far when cutting in the rectangular opening, otherwise the truck won't stay put.

Pack on top of the chassis below where the worm housing clips fit with shims to stop the truck from falling out; I used 1.5mm square plastic rod. (Note: be prepared to clip on and remove the worm housings several times before you've finished the conversion – they are fairly easy to prise apart with a small screwdriver underneath one side).

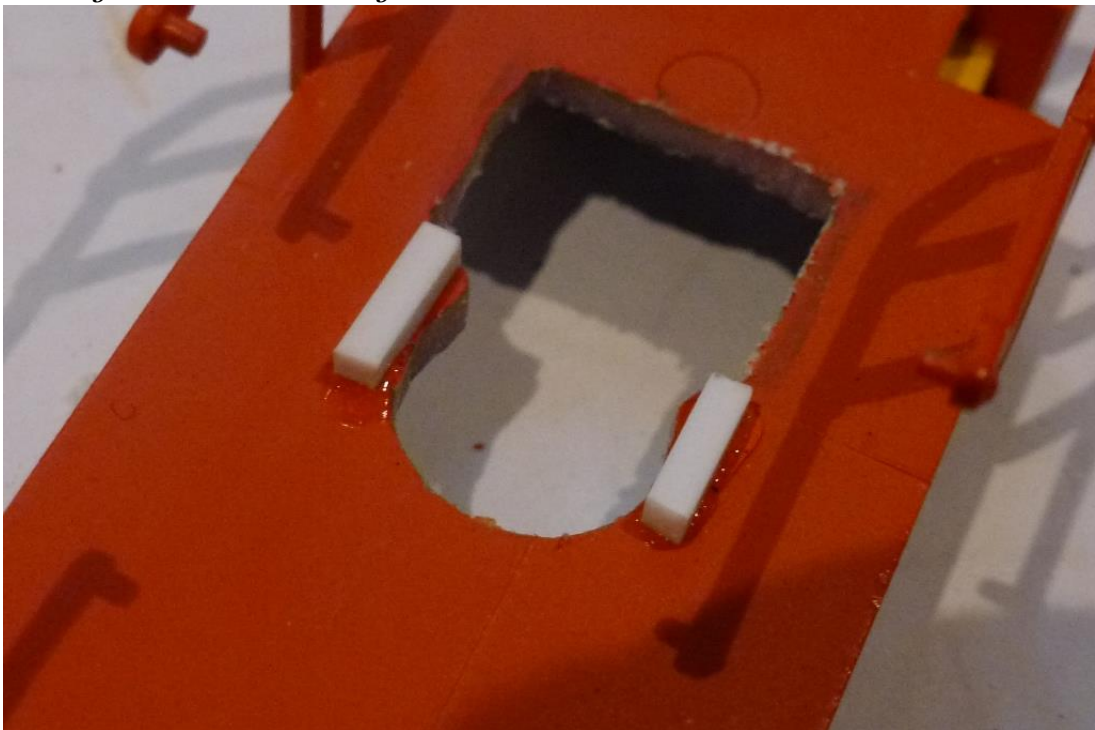
When testing the rear truck in the new hole I found the inner end caught on the end of the fuel tank so to get more rotation I rounded off the edges of the truck frame and cut off the protruding bands on the tank. In retrospect this probably wasn't necessary as the rotation limit is set by the body shell anyway.

I cut off the protruding sand pipes on the trucks as they caught against the rails round turnouts. With the sideframes in place they wouldn't be seen anyway.

Assembled truck in newly formed hole:



Packing under worm housing:



5. [Motor mount / heat sink](#)

I wanted to try and protect the plastic chassis from heat as I'd heard the Chinese motors can run hot. Using two-part epoxy, I glued a 50mm length of card from a

cereal packet to the chassis as insulation, then a strip of thin brass on top to act as a heat sink. The card and brass strips should be narrow enough for the body to fit over them. I glued a further small piece of brass on top, suitably bent at the sides, to act as a cradle for the motor.

Beware - the inside of loco body tapers slightly towards the top, so width is limited to little more than that of the motor itself. I found out by first making a heat sink to bend around the motor sides, only to find I couldn't get the body shell back on.

6. Light board

I made this from an approx. 45mm long strip of suitably gapped PCB with ready-made solder holes, and fixed it over the motor with Kapton tape.

You are limited to a height of about 21mm from the bottom edge to the top underside of the body shell, so make sure the total height of the motor mount/heat sink/light board assembly doesn't exceed this. Of course, you can do without a light board and simply solder the wires together directly as long as you take care to stop them touching the moving parts.

7. Assemble the motor/cardan/truck combo

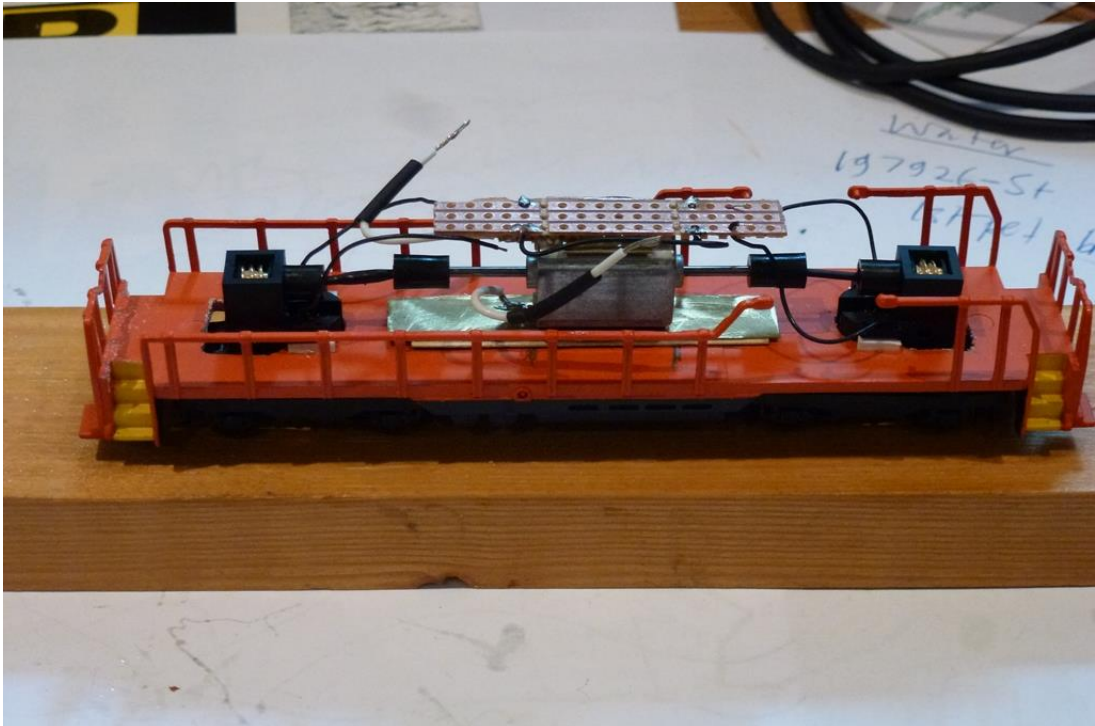
Fit the cardan bushes to the motor shafts.

I found that my batch of motors came with two different shaft lengths (47mm and 48.5mm end to end); I used the shorter one. This was just the right length with one short (11mm) and one medium length (14.5mm) cardan shaft. (I didn't know in advance which cardan shafts I needed so I bought two of each, and also two of the longer 19mm ones.)

At this stage I secured the motor assembly to the chassis cradle with Black Tack, a soft, heat resistant tacky material a bit like Blu-tack.

Working one end at a time, I placed one end of a cardan into its bush on the motor shaft, fitted a worm housing onto the other end, then clipped the worm housing down onto the truck, making sure not to trap the pickup wires.

The half-assembled mechanism before wiring and adding a brass cradle under the motor.



8. Wiring and testing

I wired for DC operation first and tested the loco without the body shell on, then wired in the decoder and lights when I was happy the loco worked. I glued the decoder onto the metal plate on the chassis behind the motor, and after soldering in the resistors and decoder wires, I taped the long stiff LED wires (suitably insulated with heat shrink tubing) horizontally under the light board so that the LEDs themselves were positioned over the worms at the same level as the lenses in the body shell.

In the end I only used the light board for the truck pickups and the corresponding red and black decoder wires. I found it easier to wire the grey and orange decoder wires direct to wires soldered to the motor terminals, and the yellow, white and blue wires direct to the relevant LEDs. I left the decoder wires at their original lengths; for the sake of neatness I should have shortened most of them as there is plenty to spare.

When I was satisfied all ran well, I stuck Kapton tape over the top of the light board as a precaution, then refitted the body, taking care that no wires were trapped or rubbing against any moving parts.

On testing again, I found that the extra weight of the body shell was causing the loco to drag slightly over some turnout switchblades, so I removed some small protrusions from the truck undersides and all was well.

The LEDs were too bright so I removed the body and wrapped some masking tape round them. There is some leakage into the number boards and cab, which I will

revisit, probably by fitting heat shrink tubing over the LEDs. If I do another conversion I'll use different LEDs.

9. Add couplers

I screwed the Kadee 713 couplers into holes drilled into Plasticard packing glued under the chassis. Because of its length, the front of the Kadee draft gearbox sticks out about 1.5mm from the front of the chassis; I packed this gap with styrene. The Micro Trains offerings, with their shorter draft gearboxes, are probably a better choice.

When you are making the holes for the couplers, be careful not to drill too far as it's easy to go right through the footplate. Guess how I found out?

Despite what I thought had been careful measuring, the couplers sit about 1mm too low and I will need to remove them and file away some of the packing.

Don't do this...



10. Add truck sideframes

I used the sideframes cut and thinned down from the original Lionel trucks. They are not the last word in realism but there again, neither are the handrails. Suitable sideframes can also be bought separately from Alex Hristov via the i.materialise 3D print website.

Still work to do! Couplers need raising slightly and the light leakage needs sorting.

